

Use of Magnesium Hydroxide for Reduction of SO₃ Emissions from Coal-fired Power Plants

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Overall Pilot Project Goal

- Demonstrate injection of Thiosorbic[®] (magnesium-enhanced lime) FGD byproduct $\text{Mg}(\text{OH})_2$ injection to produce a clear stack plume

Overview of Presentation

- Background and objectives of pilot project
 - Injection for SO_3 capture ahead of small air preheater
- Preliminary results
 - SO_3 reduction efficiency
 - Long-duration run at very low APH outlet temperature
 - Air preheater (APH) cleanliness

Overall Objectives

- Improve SO_3 reduction efficiency with byproduct $\text{Mg}(\text{OH})_2$ injection
 - Furnace injection at Bruce Mansfield Unit 3 (no SCR) yielded “clear stack”
 - Furnace injection at Gavin (with SCR) inadequate to yield “clear stack”
- SO_3 control plus increased APH reliability and future increased power generation

Background

- Post-furnace injection promised higher SO_3 capture
 - Most $\text{Mg}(\text{OH})_2$ injected in furnace likely lost via sintering or fusion with ash
 - Pilot tests by Consol R&D
 - 90% reduction after furnace at $\sim 1/2$ injection rate
 - Suggested additional pilot tests with SCR-like flue gas

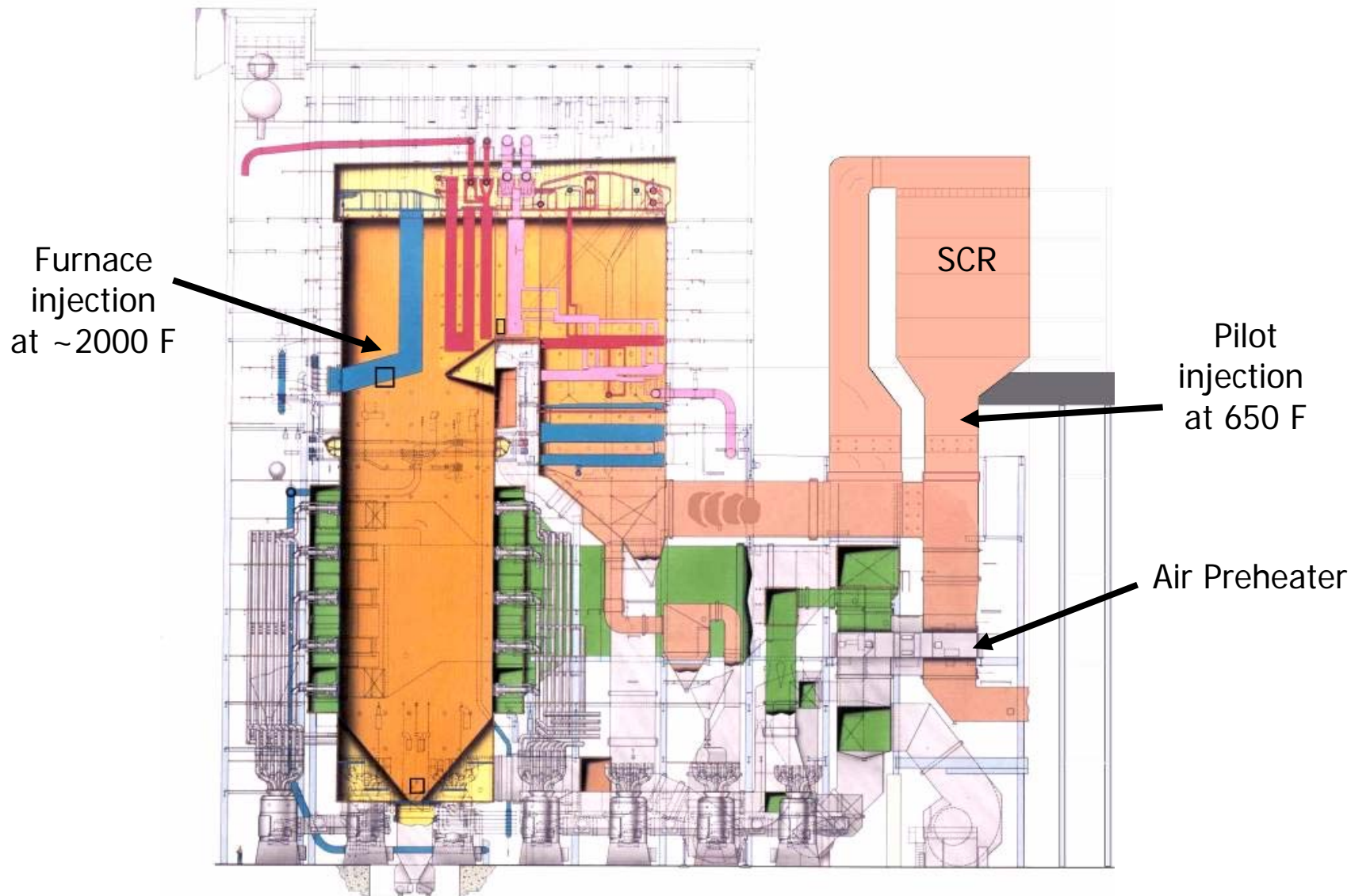
Pilot Project Participants

- Alstom Air Preheater Company
 - Providing heat transfer elements and APH operating conditions
 - Physical analysis of elements after long operation
- Consol R&D
 - Built and operated pilot for DOE mercury capture project
 - Recently won NETL grant to demonstrate mercury removal which requires SO_3 reduction with $\text{Mg}(\text{OH})_2$
- Allegheny Energy
 - Host site

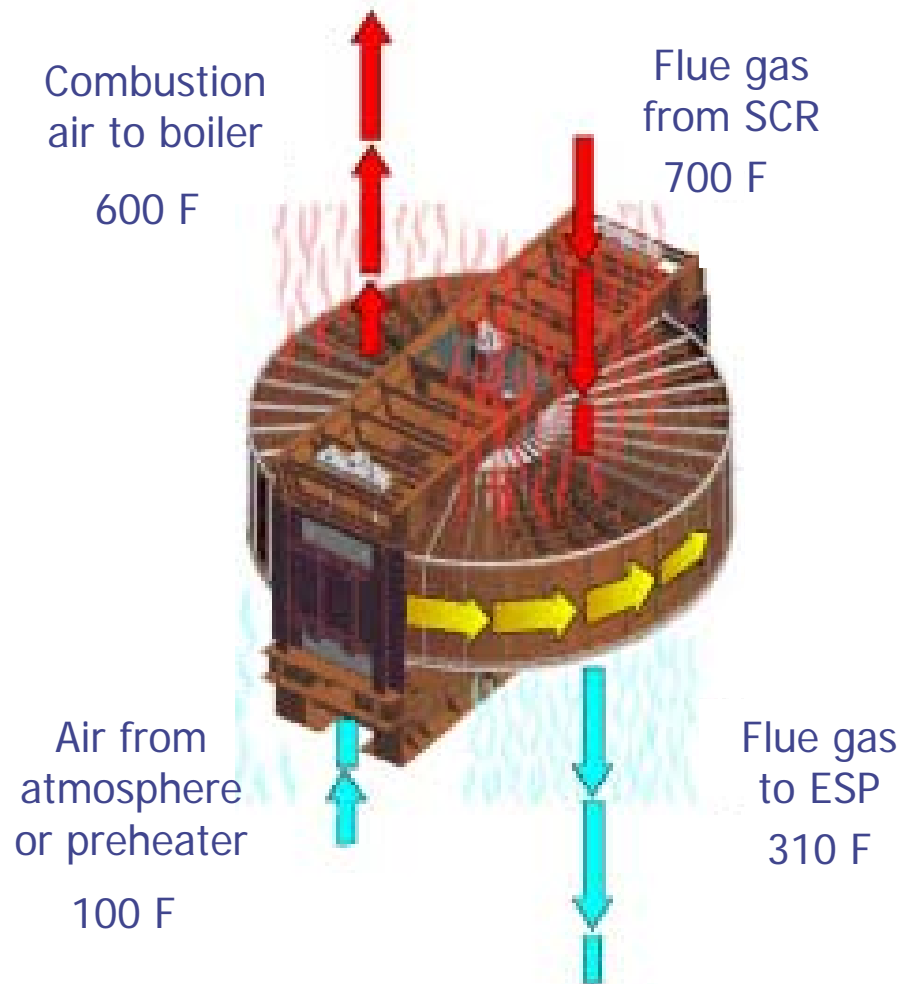
Specific Project Goals

- Immediate-term
 - <10 ppm SO_3 at pilot APH entrance
 - Expected to yield <5 ppm at stack
 - Demonstrate reliable pilot APH operation
 - Plant operations manager – “How do you know this won’t plug up my air preheater?”
- Longer-term
 - Thiosorbic FGD with SO_3 control for new power plants - <2 ppm SO_3
 - Thiosorbic FGD with SO_3 control and larger APH’s
 - 2% extra power with corresponding reduction in CO_2
 - ~ 0 ppm SO_3 at stack

Mg(OH)₂ Injection Locations



Air Preheater - Ljungström®



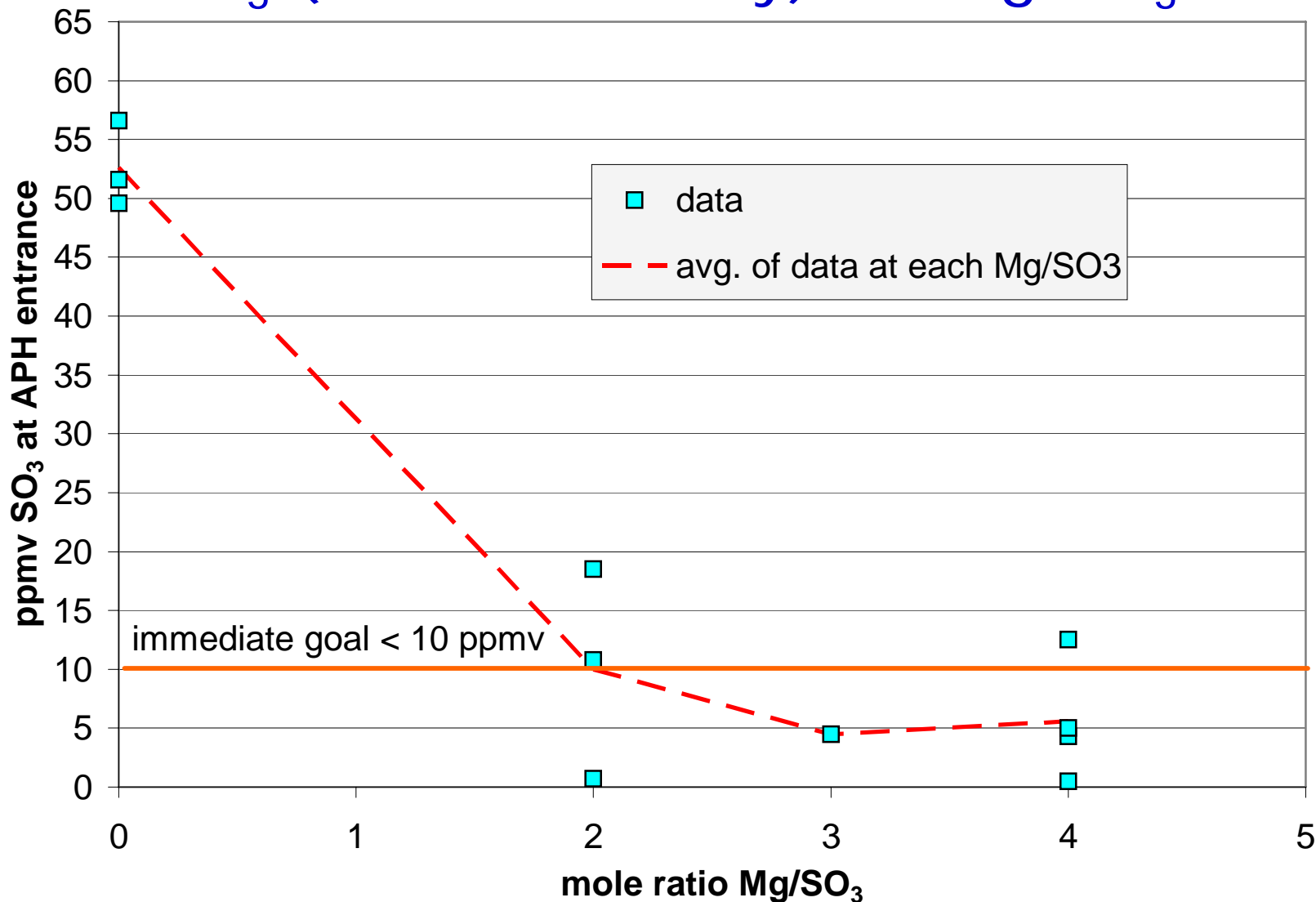
Pilot Project Operation

- SO_3 capture efficiency vs. $\text{Mg}(\text{OH})_2$ injection rate
 - SO_3 spiking system – 50-55 ppm SO_3 like SCR
- 32 day long-duration run simulating ~2% generation efficiency increase
 - 220 F flue gas exit temperature
 - 35-55 ppm SO_3 before injection
 - 3:1 Mg/SO_3 injection rate based on 50 ppmv SO_3

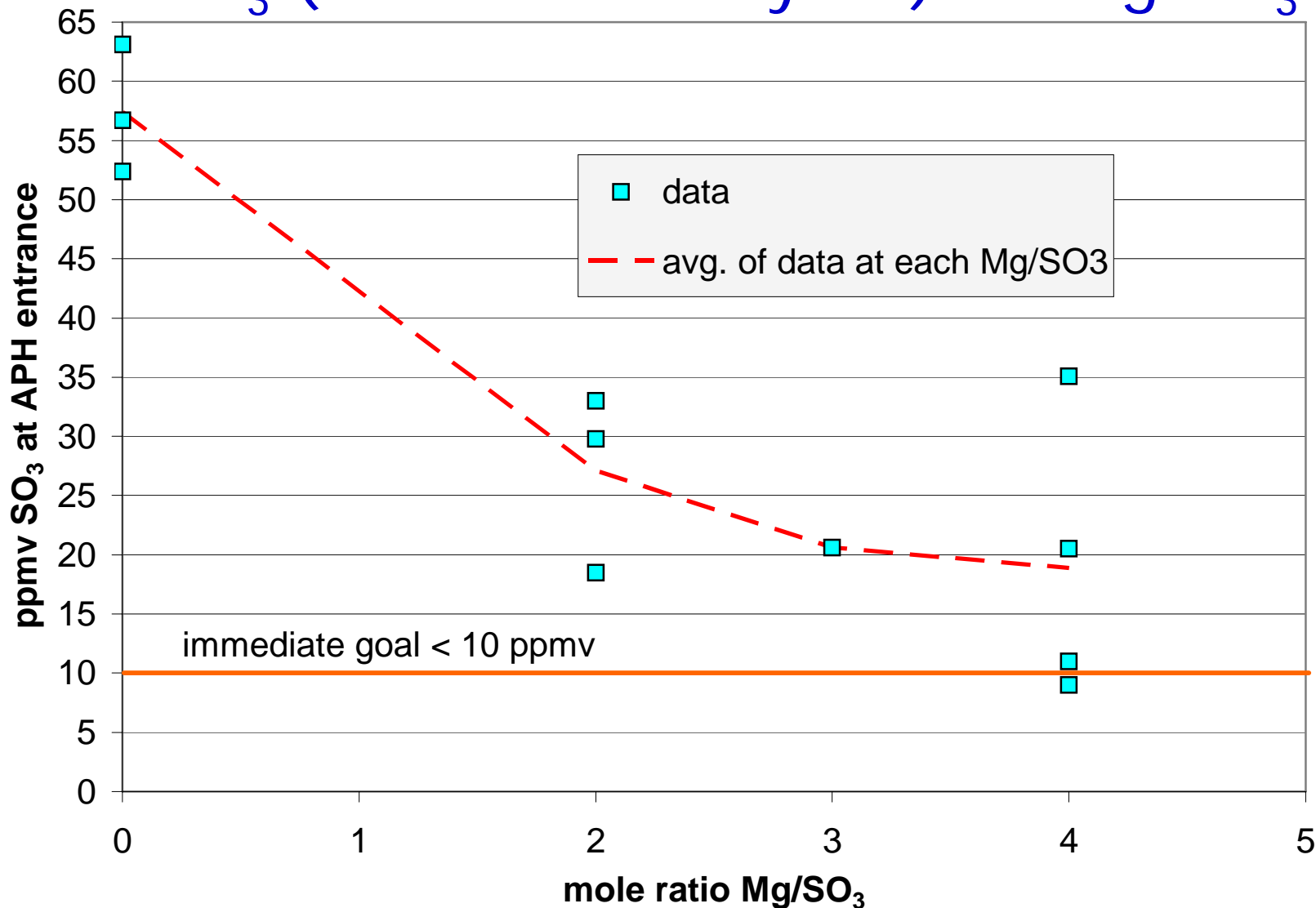
SO₃ measurement

- Clean Air Engineering proposed Method 8B
 - Modified by removing quartz thimble filter, inserted quartz wool plug in probe tip
 - Measured condenser SO₃ catch and probe SO₃ catch separately
 - Some researchers report only condenser catch
- Reagent interference
- Tried inertial sampler to exclude flyash/reagent

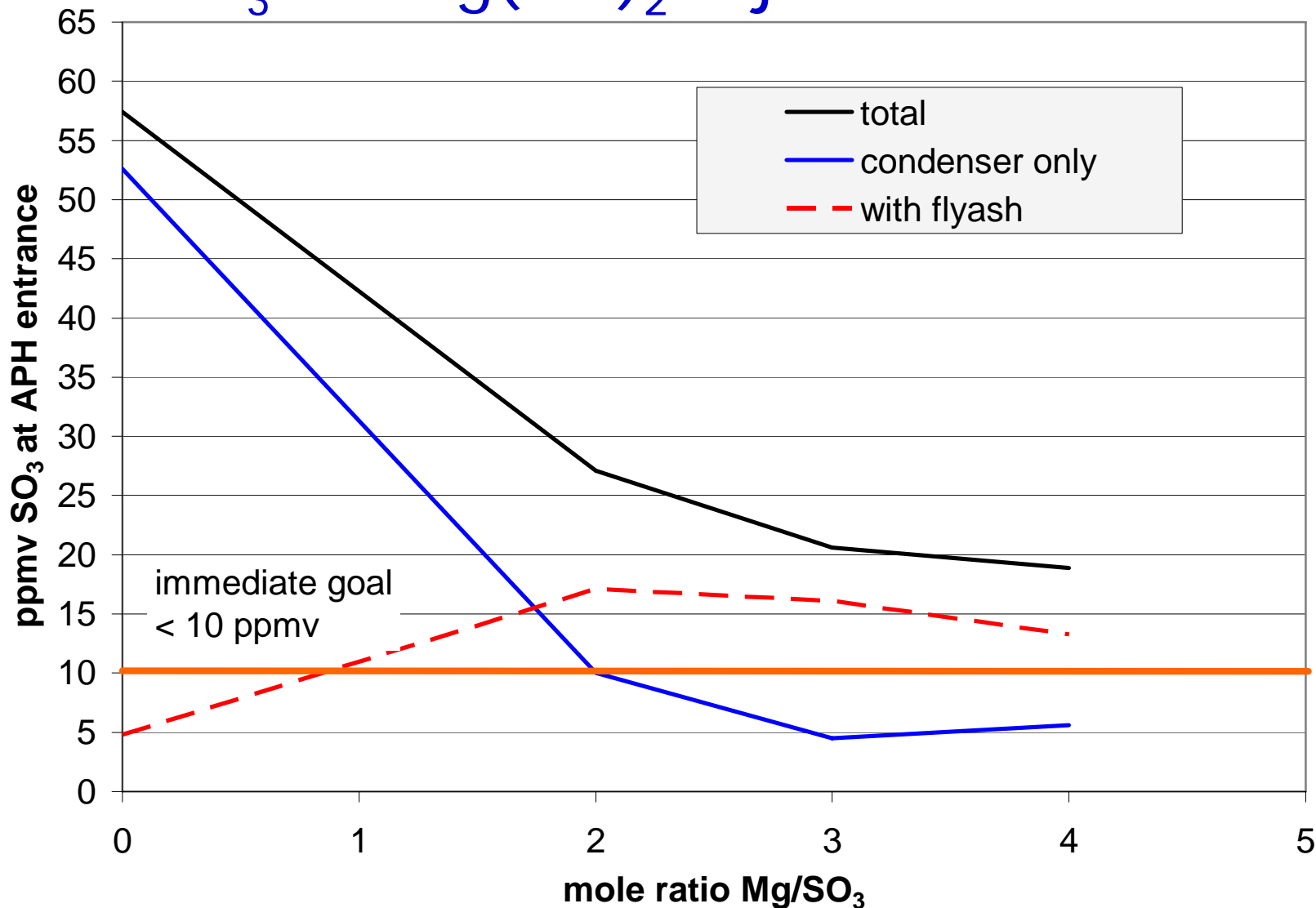
SO₃ (condenser-only) vs. Mg/SO₃



SO₃ (condenser + flyash) vs. Mg/SO₃



SO₃ vs. Mg(OH)₂ Injection Rate



Pilot Long-duration Run Results

- APH operation with $\text{Mg}(\text{OH})_2$ with 220 F at exit
 - No increase in flue gas pressure loss
 - ~3 in. H_2O
 - No acid dewpoint detected down to 115 F
 - APH baskets remained clean
- APH operation with no $\text{Mg}(\text{OH})_2$ with 220 F at exit
 - 1 in. H_2O increase in flue gas pressure loss in 4 days
 - APH baskets fouled

Pilot Air Preheater Cold-End Flue Gas Exit 32 days at 220°F with Mg Injection



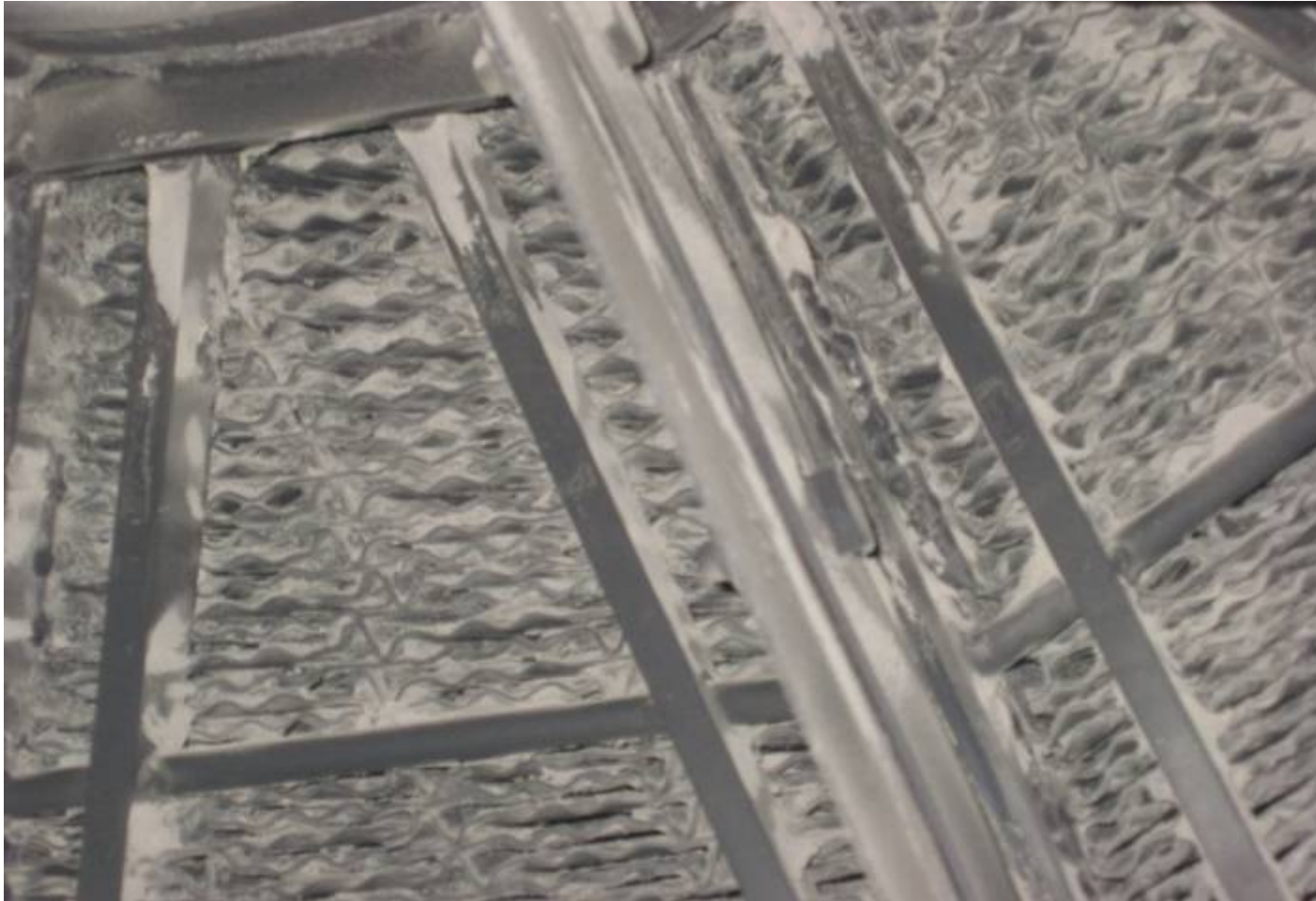
Pilot Air Preheater Cold-End Flue Gas Exit 32 days at 220°F with Mg Injection



Pilot Air Preheater Cold-End Flue Gas Exit 4 days at 220°F with no Mg Injection



Pilot Air Preheater Cold-End Flue Gas Exit 4 days at 220°F with no Mg Injection



Caveats for Commercial Scale-up of Pilot SO₃ Capture Results

- Gas residence time 1.6 secs
 - 77 ft from injection point to APH entrance
- Reagent dispersion
 - Single nozzle in 20 inch diameter duct

Summary

- Thiosorbic FGD byproduct $\text{Mg}(\text{OH})_2$ injection ahead of pilot APH reduced SO_3 to <10 ppmv
- No increase in APH pressure drop after 32 days at 220°F flue gas outlet
- APH baskets being examined by Alstom